EGU General Assembly 2023
EGU23-13006 Hall X2
Wed, 26 Apr, 14:00–15:45 (CEST)

Teaching by doing or a field course in our backyard: the first Geosensing of the Environment course in this Geography Institute

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Motivation

- Redefine the traditional "field" course in the summer of 2022 to a learning-by-doing course that does not require travel, thus is in general more accessible and has a smaller carbon footprint.

Learning Objectives

1. Ask an original scientific question
2. Independently design, build, and program electronic measurement instrument with simple micro electronics
3. Answer the scientific question by analyzing data collected with own device and communicating it scientifically

Pedagogical Framework

Input	6 course days (1 in May to launch ; 5 in August for workshop), 3 instructors (scientist, technician, assistant); 11 students (MA geography, diverse competencies in terms of science and technical, various timelines for master research)
Income	motivation of students & instructors, support from geography institute &FIL-university
Theory	constructive alignment, self-directed learning, collaborative workshop
iLOs	scientific questions; micro electronic sensors; communication of data & results
Activities	literature, presentations, observations, independent learning, ilias platform (forum, etherboard, learning resource), feedback rounds, peer-feedback, troubleshooting, field installation, visualization, inner- and intra- group exchange
Assessments	participation, presentation, proposal
Output	scientific questions, measuring devices, data sets, evaluation of learning
Outcome	technical competence, knowledge, familiarity, raspberry pi, python, field work, scientific maturity, scientific process from question to collection to data to answer to communication, exposure to proposal, good collaborators
Impact	better scientists

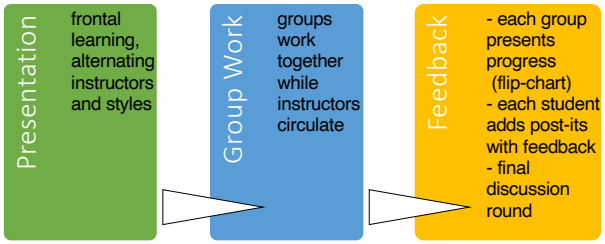
Self-Directed Learning Period (May – August)

- Goal 1: Gain a foundation with Raspberry Pi Pico
- Goal 2: Generate & Share ideas
- Tool: Illias (online learning platform) with
  - Book : Halfacree, Gareth, and Ben Everard. *Get Started with MicroPython on Raspberry Pi Pico*, 2021.

  - Forum to track progress, ask questions, troubleshoot, exchange, brainstorm
  - Library of literature and examples of self-made sensors

Collaborative Workshop: Format

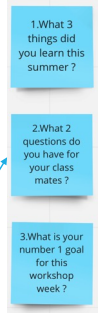
- Course Layout: 6 cycles of 3 "feedback rounds" :



- Spanned a weekend (ideally for data collection: W, Th, F >> M, T)

Six Themes:

1. Scientific Questions
2. Sensors
3. Software, Libraries, Date stamps, formats ..
4. Troubleshooting
5. Physical hardware, building
6. Data Analysis and Scientific Communication

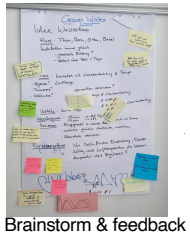


Evaluation / Check- points:

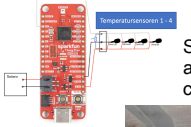
1. Transition from self-learning to workshop questions
2. Equipment Installed in the field !
3. Final Presentation
4. Proposal of a more long-term project using class work as a pilot

3 Groups, 3 themes :

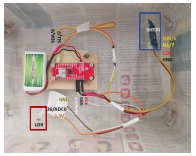
1. Water temperature in an urban pond
2. CO_2 over highway
3. Balcony Air Temperature & microclimate



Brainstorm & feedback

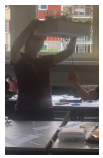


Selecting and arranging components

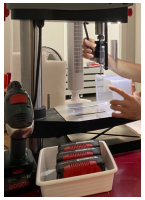


Sautering

Programming & Troubleshooting

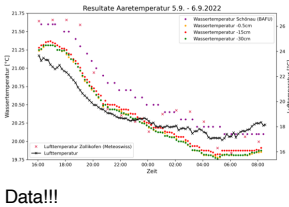


Present for feedback

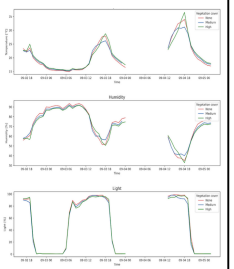


Physical hardware

Installation



Data!!!



Data!!!

Successes

- Positive reviews from students
- Open-ended nature of the course, adapted to individual interests
- Integration of 2 phases
- Each group had data from a self-made device that they built starting with a blank sheet of paper (and a raspberry pi).
- Focus on instrumentation transcended disciplines (a plus in Geography! Expand)
- Base for future MA projects.

Observations

- sparkfun thing plus RP2040 sometimes is better adapted than raspberry-pi pico
- Tradeoff: empower each student to "start from scratch" or provide ready-to-go kits?
- Challenge = teaching technical subjects in non-technical discipline. Start from basic; allow time for troubleshooting.
- Feedback rounds were not always popular; restructure so that sharing happens *within* more than *between* groups.

Ideas for Future

- Include python data analysis in the self-directed learning module
- Expand duration but keep hours constant, so more time for troubleshooting
- Include real-time clock, energy source, and communication tool (e.g., LoRa) in "kit" and instruction
- Build two different devices, with different groups so contribute differently skills and not "specialize", also increases learning potential from feedback. E.g, a comparison of available sensors to foundational skills
- Improve assessment so more individual (vs. group) & concrete (vs. participation), e.g., 1:1 interview to explain device.

Acknowledgements

- Support from the "Förderung Innovative Lehre (FIL)" via the Vice Rectorate of Teaching at the University of Bern